Pest Management Grants Final Report

Agreement No. 99-0211

Development of an Integrated System for Controlling San Jose Scale, Peach Twig Borer and Oriental Fruit Moth in Clingstone Canning and Fresh Shipping Peaches, Plums and Nectarines

Principal Investigator: Jonathan Field

Contractor Organization: California Tree Fruit Agreement

Date: February 28, 2001

Prepared for the California Department of Pesticide Regulation

Disclaimer

The statements and conclusions in this report are those of the contractor and not necessarily those of the California Department of Pesticide Regulation. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

ACKNOWLEDGMENTS

Pest Management Demonstration Grant Participants

Name	Title	Affiliation
Jonathan Field	P.I., Manager	California Tree Fruit Agreement 30 years agricultural experience
Gary Van Sickle	Field Director	California Tree Fruit Agreement 36 years agricultural experience
Jason Chavez	Research Coordinator	California Tree Fruit Agreement 10 years agricultural experience
Heidi Sanders	Research Coordinator	California Cling Peach Growers Advisory Board 10 years agricultural experience
Dr. Kent Daane	Entomologist	UC Berkeley - Kearney Ag Center Researches and implements biological control practices
Walt Bentley	Pest Management	UCCE - Kearney Ag Center Researches and implements reduced risk practices
Janine Hasey	Farm Advisor	UCCE - Sutter and Yuba Counties Researches and implements reduced risk practices
Carolyn Pickel	IPM Advisor	UCCE - Sacramento Valley Researches and implements reduced risk practices
Kevin Day	Farm Advisor	UCCE - Tulare County Pomologist for stone fruit
Richard Coviello	Entomologist	UCCE - Fresno County Researches and implements reduced risk practices
Beth Grafton-Cardwell	Entomologist	UC Riverside – Kearney Ag Center Extensive experience with scale
Harry Andris	Farm Advisor	UCCE – Fresno County Stone and pome fruits
Shawn Steffan	Staff Research Associate	Kearney Ag Center Coordinates field activities
Steve Strong	Grower/PCA	CTFA Research Subcommittee, Venida Packing
Bill Green	PCA/Grower Relations	CTFA Research Subcommittee, LVR Corp.
Rod Milton	Grower	CTFA Research Subcommittee
John Tos	Grower	CTFA Peach Administrative Committee, Tos Farms, Inc.
Bill Tos	Grower/PCA	Tos Farms, Inc.
Rick Schellenberg	Grower	CTFA Nectarine Administration Committee, Schellenberg Farms
Norman Kline	Grower	CCPGAB Research Chairman
Mike Noland	Grower	Quinco Corporation

This report was submitted in fulfillment of Agreement No. 99-0211, Development of an Integrated System for Controlling San Jose Scale, Peach Twig Borer and Oriental Fruit Moth in Clingstone Canning and Fresh Shipping Peaches, Plums and Nectarines by California Tree Fruit Agreement under the [partial] sponsorship of the California Department of Pesticide Regulation. Work was completed as of February 28, 2001.

Table of Contents

LIST OF FIGURES

Pheromone Trap Counts

LIST OF FIGURES
Continued

Pheromone Trap Counts

LIST OF TABLES

ABSTRACT

The purpose of this demonstration project, has been to implement and evaluate an integrated and sustainable pest management program for peaches, plums, and nectarines in California. The research has focused on managing San Jose scale (SJS), peach twig borer (PTB), oriental fruit moth (OFM), omnivorous leafroller (OLR), katydids and western flower thrips. Most elements of the Pest Management Grant's activities have been presented to growers and pest control advisors (PCAs) at meetings held this past season at or near the demonstration sites. In addition, information developed as a part of this research effort has been and will continue to be disseminated through grower newsletters, University of California publications / meetings, and on CTFA's website.

Stonefruit producers have traditionally relied upon organophosphate (OP) and carbamate insecticides to control many primary pests. The enactment of the Food Quality Protection Act (FQPA), has forced the stone fruit producers to reevaluate traditional pest management practices, and to explore new techniques and materials. Due to environmental and human health concerns raised by the FQPA, a concerted effort has been made by the stone fruit industry in cooperation with the University of California and through partial sponsorship from the Department of Pesticide Regulation, to demonstrate and evaluate the use of reduced-risk practices and materials. This demonstration project has examined the use of commercially available oils, pheromone dispenser systems, and reduced-risk pesticides in commercial orchards, under controlled research methodology. The information gathered from the demonstration project will aid in the development of best management practices for stone fruit production, by incorporating many of the integrated pest management (IPM) approaches developed by the University of California. In addition, the development of an augmentative biological control program may increase SJS parasitism and further reduce the need for insecticide applications.

During this second year, progress towards meeting the objectives was achieved. First, efficacy studies of commercially available PTB and OFM pheromone disruptants has been completed. Second, efficacy trials of two commercially available oils as the single component in a dormant spray for controlling SJS have been conducted. The results suggest that both oil formulations may abate overwintering SJS in orchards with low to moderate population densities. Third, the reduced-risk chemical Success® (Spinosad) has shown potential to be an alternative to the industry standard, Carzol® (Formetanate hydrochloride), for thrips control. Grower feedback is now being received regarding the efficacy of Success® from this past season, when used as an in-season treatment for control of thrips. Fourth, a preliminary survey of endemic and commercially reared natural enemies of SJS has been completed. One commercially available, and two endemic enemies have been identified. To date, laboratory colonies of the two endemic parasitoids have been established. The development of an augmentative release program of the most effective parasitoids continues. Fifth, three grower demonstration sites were established in Fresno, Kings and Yuba Counties, demonstrating reduced-risk practices on 8 varieties of peaches, plums and nectarines. Finally, industry education and information dissemination was achieved and continues through industry sponsored educational field days, research newsletters and commodity websites.

EXECUTIVE SUMMARY

The objective of this ongoing project has been to develop an integrated and sustainable pest management program for peaches, plums, and nectarines in California. The research has focused on control of San Jose Scale (SJS), peach twig borer (PTB), oriental fruit moth (OFM), omnivorous leafroller (OLR), katydids and wetern flower thrips. Information gathered from the pest management demonstration has been presented to growers and PCAs, at meetings at or near the demonstration plots. In addition, information developed as a part of this research effort was disseminated through educational field days, research newsletters and via pest management and commodity websites.

During this year of this demonstration project, substantial progress towards meeting the objectives has been made. A brief description of the objectives, the specific tasks and accomplishments follow:

Objective 1: Complete efficacy trials and data collection for pheromone mating disruption, new insecticides and oils available for commercial use.

Specific Task I: a) Evaluation of the efficacy of commercially available and experimental pheromone products for mating disruption of OFM and PTB. Evaluations have been conducted for commercial pheromone mating disruptants. Data indicates that pheromone disruptants can be used to successfully maintain OFM and PTB below economic injury levels. b) Integrate programs of pheromone and insecticide for control of OFM and PTB. Data indicates that use of materials such as Success® (Spinosad) complement pheromone disruptant programs for control of OFM and PTB. c) Efficacy testing for control of obliquebanded leafroller (OBLR). Data indicates that use of materials such as DiPel® (*Bacillus thuringiensis, Bt*) and Success® are effective in controlling OBLR.

Specific Task II: Continue reduced-risk material efficacy trials for controlling thrips under controlled research plot conditions. Efficacy trials for bloom-timed applications of 3 reduced-risk materials, Agri-Mek® (Abamectin), Esteem® (Pyriproxyfen), and Success® (Spinosad) have been completed. The results from this year's trials are consistent with the results of last year's trials, in that both reduced-risk materials, Success® and Agri-Mek®, were statistically equivalent to the traditional material Carzol® (Formetanate hydrochloride) for control of thrips damage. Currently, Agri-Mek® is not registered for stone fruit.

Specific Task III: Examine efficacy of commercially available oils for controlling SJS. Efficacy trials of two commercially available oils as the single component in a dormant spray for controlling SJS have been conducted. The results suggest that both oil formulations may abate overwintering SJS in orchards with low to moderate population densities.

Objective 2: Begin augmentative release efficacy trials with selected natural enemies for control of SJS.

Specific Task I: a) Establish insectary colonies of the more common and effective resident SJS parasitoids. Colonies of the resident parasitoids *Aphytis vandenboschi* and *Encarsia perniciosi* have been established. *b*) Determine the effect of commonly used insecticides on selected natural enemies. Laboratory trials have been conducted, however, analysis of data continues. c) In laboratory trials, test the effectiveness of commercially available SJS parasitoids. Trials have been completed regarding the effectiveness of the only commercially available scale parasitoid, *Aphytis melinus*. Data indicates that *A. melinus* will parasitize SJS, but only if SJS is the only host available. Also, the level of parasitism by *A. melinus* was lower than expected. d) Test selected SJS parasitoids for use in augmentative release programs. This task is still in progress at this time.

Objective 3: Implement 4 grower demonstration plots (Fresno, Kings, Sutter and Yuba Counties) which employ oil and Insect Growth Regulators for controlling SJS, pheromone mating disruption for controlling PTB and OFM, intensive monitoring for secondary and primary pest pressure to evaluate the need, if any for clean-up material use.

Specific Task I: Implement a minimum of 3-4 grower demonstration plots, one each in Fresno, Kings, Sutter/Yuba Counties. Three grower demonstration orchards were established in Fresno, Kings and Yuba Counties, incorporating approximately 72 acres (8 varieties) of peaches plums and nectarines. The grower cooperators were Rick Schellenberg of Fresno County who contributed 24 acres of freestone peaches, plums and nectarines, Tos Farms of Kings County who contributed 20 acres of nectarines and Mike Noland, Quinco Corp. of Yuba County who contributed 28 acres of cling peaches. The data obtained from this year's demonstration blocks illustrate, in general, higher insect activity in the Fresno and Kings County reduced-risk practice (RRP) blocks, compared to the conventional (CON) blocks. However, there were also higher populations of the SJS parasitoids *Aphytis spp.* and *Encarsia perniciosi* in the RRP blocks. Another measure used by researchers to assess how the reduced-risk program preformed compared to the conventional program, was the percentage of fruit "culled," or unpacked, because of insect damage. The data illustrates that within each variety there was no statistical difference between the two pest management programs. Furthermore, this was also true of the overall performance when both pest control methods were grouped in their respective programs.

Objective 4: Implement a grower education and outreach program to routinely showcase grower demonstration plots.

Specific Task I: Utilize the communications infrastructure of CTFA and CCPGAB to enhance the exchange of information and project progress between growers and researchers. To date, five grower education days have been held with approximately 400 growers, PCAs, PCOs and other interested parities attending. In addition, CTFA mailed quarterly newsletters, highlighting progress made on the demonstration to over 2,600 growers and interested parties. CCPBAG also published and mailed newsletters to over 400 growers and interested parties.

REPORT

A. Introduction

The scope and the purpose of the project has been to take a statewide approach, through the support of the California Department of Pesticide Regulation and combined efforts of the California Tree Fruit Agreement (CTFA), the California Cling Peach Growers Advisory Board (CCPGAB), the University of California, the California State University Agricultural Research Initiative, Schellenberg Farms, Tos Farms, Quinco Corporation, Dow AgriSciences, Ecogen and Exxon. It is intended to advance the benefits of a coordinated comprehensive SJS, PTB and OFM research effort, with no one area of the research promising complete solutions to the problems currently being experienced by the stone fruit industry. This is being accomplished through the development of a system where the combination of replacing OPs with oil, pheromone mating disruption and developing a system for orchard augmentation with natural enemies will maintain SJS, PTB and OFM populations below an economic injury level.

The attainment of the multiple pest management system, where OP and carbamate use is reduced or eliminated, is designed to curtail the potential for pest outbreaks, conserve endemic and augmented natural enemies, increase grower confidence in the efficacy of alternative reduced risk materials, and sustain the economic viability of production costs over time. Moreover, the project is intended to mitigate environmental impacts from the use of OPs and carbamates by reducing the influx of runoff into surface and subterranean water systems.

The following is a list of the objectives, the specific tasks for each objective and the person or party responsible for conducting the tasks:

Objective 1: Complete efficacy trials and data collection for pheromone mating disruption, new insecticides and oils available for commercial use.

Specific Task I: a) Evaluation of the efficacy of commercially available and experimental pheromone products for mating disruption of OFM and PTB, b) integrate programs of pheromone and insecticide for control of OFM and PTB, and c) efficacy testing for control of obliquebanded leafroller (OBLR). The principal investigator for this task was Janine Hasey, University of California Farm Advisor.

Specific Task II: Continue reduced-risk material efficacy trials for controlling thrips under controlled research plot conditions. The principal investigator for this task was Richard Coviello, University of California Farm Advisor.

Specific Task III: Examine efficacy of commercially available oils for controlling SJS. The principal investigator for this task was Walt Bentley, University of California Regional IPM Advisor.

Objective 2: Begin augmentative release efficacy trials with selected natural enemies for control of SJS.

Specific Task I: a) Establish insectary colonies of the more common and effective resident SJS parasitoids. b) Determine the effect of commonly used insecticides on selected natural enemies. c) In laboratory trials, test the effectiveness of commercially available SJS parasitoids. d) Test selected SJS parasitoids for use in augmentative release programs. The principal investigator for this task was Dr. Kent Daane, University of California Center for Biological Control Entomologist.

Objective 3: Implement 4 grower demonstration plots (Fresno, Kings, Sutter and Yuba Counties) which employ oil and Insect Growth Regulators for controlling SJS, pheromone mating disruption for controlling PTB and OFM, intensive monitoring for secondary and primary pest pressure to evaluate the need, if any for clean-up material use.

Specific Task I: Implement a minimum of 3-4 grower demonstration plots, one each in Fresno, Kings, Sutter/Yuba Counties. Walt Bentley, Kent Daane, Janine Hasey, Gary Van Sickle (CTFA) and Heidi Sanders (CCPGAB) were responsible for this portion of the project.

Objective 4: Implement a grower education and outreach program to routinely showcase grower demonstration plots.

Specific Task I: Utilize the communications infrastructure of CTFA and CCPGAB to enhance the exchange of information and project progress between growers and researchers. Jason Chavez, CTFA Research Coordinator and Heidi Sanders, CCPGAB Research Coordinator were responsible for this portion of the project.

B. Results

Objective 1: Complete efficacy trials and data collection for pheromone mating disruption, new insecticides and oils available for commercial use.

Specific Task I: The approach used in the northern Sacramento Valley relied primarily on the use of pheromones for mating disruption of OFM and PTB. The pheromone disruptant used for OFM was Isomate M-100®, by Pacific BioControl and the disruptant used for PTB was Checkmate PTB®, by Consep. The disruptants appeared to manage the populations of OFM and PTB. However, secondary pests such as lygus and OBLR required treatments of DiPel ® (*Bacillus thuringiensis*) or Success® (Spinosad). Additionally, puffer technology and paraffin wax emulsion mixtures were not used this season. The Bt approach can be used for control of OBLR, although treatments with Success® were quite effective on this pest. Currently, there are no good alternatives to managing lygus or stinkbug. Until effective products become available, these pests will be managed with OP or carbamate materials.

Specific Task II: Evaluation of the bloom-time applications for all materials has been completed. All materials, except Esteem®, significantly reduced thrips damage. The results from this year's trials are consistent with the results of last year's trials, in that both reduced-risk materials, Success® and Agri-Mek®, were statistically equivalent to the traditional material Carzol® for control of thrips damage (Table 1). SJS activity was also monitored following

treatment. For the bloom-time application, none of the materials significantly reduced SJS fruit infestation below the untreated control block. However, the Carzol® treated block yielded significantly more scale-infested fruit than the control block.

Specific Task III: The specific task for this portion of the project was met. Data collected from traps and scale infestation indicate both Orchex 692 and Volk Supreme oils were effective in managing moderate populations of SJS when applied in a dilute dormant application. Both treatments showed significant reductions in the number of fruit infested with SJS at the time of harvest when compared to the untreated check block. [Data for this task has already been presented in the final report for year 1 of this demonstration.]

Objective 2: Begin augmentative release efficacy trials with selected natural enemies for control of SJS.

Specific Tasks I: a)The establishment of laboratory colonies, of the more common and effective parasitoids, *Encarsia perniciosi* and *Aphytis vandenboschi,* has been successful. b) Leaf-dip bioassay to determine the relative toxicity of commercially used insecticides to natural enemies was completed in late January, 2001. Consequently, data from the bioassay is still being analyzed. Preliminary testing of Dimilin®, Success®, and Confirm® for control of OFM and PTB has been conducted in an almond orchard to determine the potential effects on non-target organisms. The application of each material has been accomplished. The day following application, samples of treated nuts were collected from the field. Non-target organisms (*Encarsia sp., Aphytis spp., Chrysoperla sp. and Goniouzus*) were exposed to the treated nuts under laboratory conditions and monitored for mortality. Researchers are analyzing data from the exposure process. Leaf-dip tests to determine the potential effects of these materials on non-target organisms began in October and concluded in late December, 2000. Analysis of the data continues. c) Laboratory trials have been completed regarding the effectiveness of the only commercially available scale parasitoid, *Aphytis melinus.* Laboratory trials indicate that *A. melinus* will parasitize SJS, but only if SJS is the only host available. Also, the level of parasitism by *A. melinus* was lower than expected. *d*) Testing of selected SJS parasitoids for use in an augmentative release program continues.

Objective 3: Implement 4 grower demonstration plots (Kings, Fresno, Sutter, and Yuba Counties) which employ oil and Insect Growth Regulators for controlling SJS, pheromone mating disruption for controlling PTB and OFM, intensive monitoring for secondary and primary pest pressure to evaluate the need, if any, for clean-up material use.

Specific Task I: Three grower demonstration orchards were established in Fresno, Kings and Yuba Counties. The grower cooperators were Rick Schellenberg of Fresno County who contributed 24 acres of freestone peaches, plums and nectarines, Tos Farms of Kings County who contributed 20 acres of nectarines and Mike Noland, Quinco Corp., of Yuba County who contributed 28 acres of clingstone peaches. The term reduced-risk practice (RRP) is used here and in the data tables to identify the orchards that did not use OPs or carbamate insecticides and in lieu of, reduced-risk materials and practices were implemented. The term (CON) is used here and in the data tables to identify the orchards that employed conventional materials and management practices.

Extensive monitoring of both the reduced-risk and the conventional sites has produced valuable information for future use by the stone fruit industry. Trends between the two programs remain consistent. The data obtained from this year's demonstration blocks illustrate, in general, higher insect activity in the RRP blocks, compared to the CON blocks (Figures 1.1-5.6). However, there were also higher populations of the SJS parasitoids *Aphytis spp.* (Figures 1.5, 2.4, 3.4, 4.4, 5.5) and *Encarsia perniciosi* (Figures 1.6, 2.5, 3.5, 4.5, 5.6) in the RRP blocks.

Field samples of fruit were taken prior to harvest to record the percentage of fruit without insect damage. Within each variety there was no statistical significance between the two approaches, however, when the RRP and the conventional programs were grouped for "overall comparison of fruit without insect damage," the RRP blocks averaged 86.19%, while the conventional blocks averaged 89.34% (Table 2).

Another measure used by researchers to assess how the reduced-risk program preformed compared to the conventional program, was the percentage of fruit "culled," or unpacked because of insect damage. The data illustrates that within each variety there was no statistical difference between the two pest management programs. Furthermore, this was also true of the overall performance when both pest control methods were grouped in their respective programs. The RRP orchards averaged a cull rate of 5.69%, while their conventional counterparts averaged a cull rate of 4.53% (Table 3). There was no damage attributed to leafrollers in the Fresno and Kings County orchards.

In the Yuba County orchards, worm damage attributed to OFM and PTB was detected in only the Starn/Hesse comparison RRP block. Since only live OFM were found, damage was attributed to that species. In the standard comparison block (Hesse) there was 1.2% worm infestation while the Starn RRP comparison resulted in 4.4% (Table 4.). The Starn RRP orchard, using OFM mating disruption, was sampled from the north (6.5% infested fruit) and the south (3% infested fruit). The RRP orchard was only 6.5 acres in size and long and narrow in shape. The size and shape would allow for easy movement of mated moths from untreated areas. Yield was also relatively low providing fewer fruit on which mated moths could concentrate. None of the other comparisons resulted in OFM or PTB damage.

Obliquebanded leafroller became a problem in the RRR orchards in Yuba County. Although each of the RRP blocks in Yuba County were treated with 2 *Bacillus thuringiensis* sprays in the spring for PTB, these treatments did not control OBLR in the late harvested (8/21 - 8/25) Starn and Hesse comparison. For the orchards in Yuba County, OBLR caused the greatest amount of fruit damage. The Standard Hesse orchard resulted in 2.6% OBLR damage and the Starn RRP orchard resulted in 3.2% damage (Table 4.). The Ross RRP block (harvested 8/14) resulted in 5% damage while the Standard block recorded 0.8% (Table 4.).

Objective 4: Implement a grower education and outreach program to routinely showcase grower demonstration plots.

Specific Task I: Thus far, five field days sponsored and publicized by California Tree Fruit Agreement, California Cling Peach Growers Advisory Board and the University of California have been conducted. The events were held to inform growers, PCAs, PCOs, government representatives, the stone fruit industry and the public about progress made on the project. A Pest Management Demonstration meeting was held on April 13th at the Tos Farms site located

in Kings County. Over 75 growers, PCAs, PCOs, shippers, researchers, county agricultural inspectors and other interested parties attended the event. Cling peach Pest Management update meetings were held on April 20th and June 30th at the demonstration block located in Yuba County, with approximately 32 and 25 people attending the events. The fourth and fifth educational meetings were held on July 13th and October 11th at the University of California Kearney Agricultural Center. Over 130 growers, PCAs, PCOs, shippers, researchers and other interested parties attended each of the UC KAC events. In addition to printed information provided by UC researchers, CTFA's annual Research Report was made available during the events.

CTFA's quarterly newsletters were sent to over 2,600 growers, PCAs, PCOs, shippers, packers and other parties associated with the fresh market stone fruit industries discussing project progress. CCPGAB also mailed newsletters to over 400 cling peach growers, PCAs and PCOs highlighting progress made on the project. Information from the demonstration project was also made available to the public via CTFA's web site. In addition, Gary Van Sickle of CTFA presented information regarding the progress of the project to the Tulare-Kings chapter of the California Agricultural Production Consultants Association (CAPCA), with approximately 175 professional agricultural consultants in attendance.

C. Discussion

This was the second year of a comprehensive pest management demonstration project. A systems approach (intensive field monitoring, use of mating disruption, use of biological agents and implementation of reduced risk materials) was implemented to examine reduced-risk alternatives for controlling SJS, PTB and OFM in clingstone and fresh market peaches, plums and nectarines. The objectives of this demonstration project distinctly sought to substantially reduce reliance on OPs/carbamates and provide a model sustainable pest management system for stone fruit growers throughout the state of California. The intent of this project has been to encourage movement towards adoption of reduced-risk practices through demonstration in commercial orchards.

This phase of the project compared the efficacy of commercially available horticultural oil as the single component in a dormant spray for controlling SJS, compared to a traditional OP/oil application, and found moderate populations of scale could be controlled under dilute application rates. The Insect Growth Regulator Esteem® (Pyriproxyfen) was available to stone fruit growers during the 1999-2000 dormant period, under a Section 18 exemption for use in California, for control of SJS. Approximately 750 gallons of this reduced-risk material was used by California peach, plum and nectarine growers, treating approximately 7,500 acres of the 15,000 acres eligible for use of the product. It must be assumed that only those growers with serious SJS infestations used Esteem®, and had it not been available the 7,500 acres would have been treated with OPs or carbamates. Grower awareness and adoption of new and effective reduced-risk products has been heightened by cooperative projects such as the Pest Management Alliance and Pest Management Grant.

D. Summary and Conclusions

Overall, advancement in the objectives for the second year of the project was achieved. A preliminary analysis of the data indicates SJS, PTB and OFM populations may be maintained below an economic injury level in stone fruit without or with minimal use of OPs and carbamates.

Work was completed to evaluate the efficacy of commercially available pheromone mating disruptants for controlling damage from OFM and PTB. The efficacy results indicate that OFM and PTB can be successfully managed by utilizing pheromone disruptants.

Progress was made regarding control of thrips. Two potential alternatives, Success® and Agri-Mek®, again demonstrated satisfactory control compared to the industry standard Carzol®, and have reaffirmed the results of last year's trials. Grower feedback is now being received regarding successful results from Success® this past season when used as an in-season treatment.

Data from this year's demonstration project are consistent with results from last year regarding commercially available horticultural oils. Results indicate that oils can be used without OPs or carbamates, when trees are dormant, at dilute rates to successfully mange low to moderate populations of San Jose scale.

Progress was also made in development of a biological and economically viable inundative release program for natural enemies of SJS. Commercial orchards were surveyed and endemic natural enemies of SJS were identified. As a result, laboratory colonies of two potential groups of parasitoids, *Encarsia perniciosi* and *Aphytis vandenboschi*, have been established as a potential source for agents used in an augmentative biological control program.

In December 1999, 3 grower demonstration plots were established in Fresno, Kings and Yuba Counties. A total of approximately 72 acres (8 varieties) were utilized in this demonstration project. The sites incorporated the reduced-risk practices outlined in this project. The implementation of the demonstration blocks focused on addressing the dynamic pest management pressures in a commercial setting, from dormancy, through harvest and back to dormancy.

The CTFA and CCPGAB utilized their communications infrastructures to sponsor and publicize UC grower education days, publish quarterly newsletters and maintain active websites highlighting progress made on the Pest Management Grant project. Through this continued effort, hundreds of growers and professional crop care consultants have been exposed to alternative, reduced-risk practices that effectively address the pest complexes of the stone fruit industry.

Finally, the successful demonstration of utilizing horticultural oils in dilute dormant applications in combination with pheromone mating disruption, use of new reduced-risk materials and the development of an augmentative parasitoid program in a commercial setting, should increase grower confidence in the efficacy of alternative materials and reduced risk practices.

Appendix

FIGURES

Elegant Lady Peaches Pheromone Trapping Counts

Figure 1.1

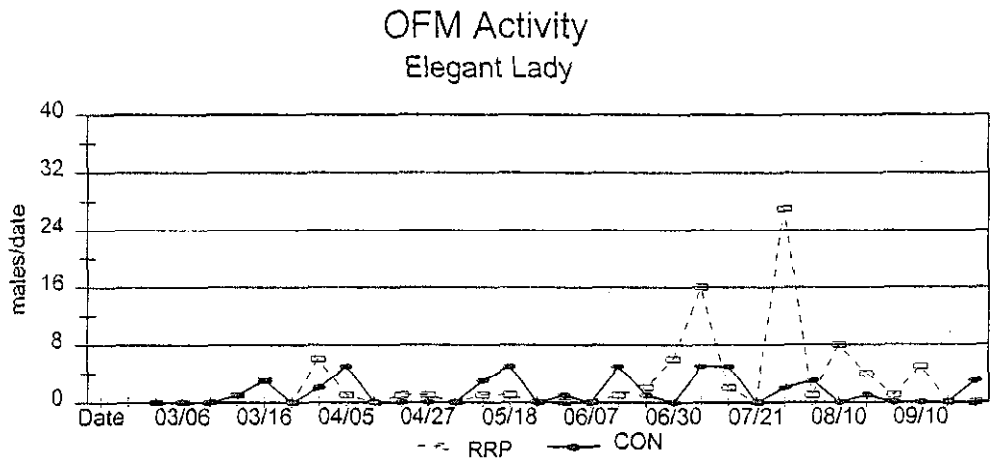


Figure 1.2

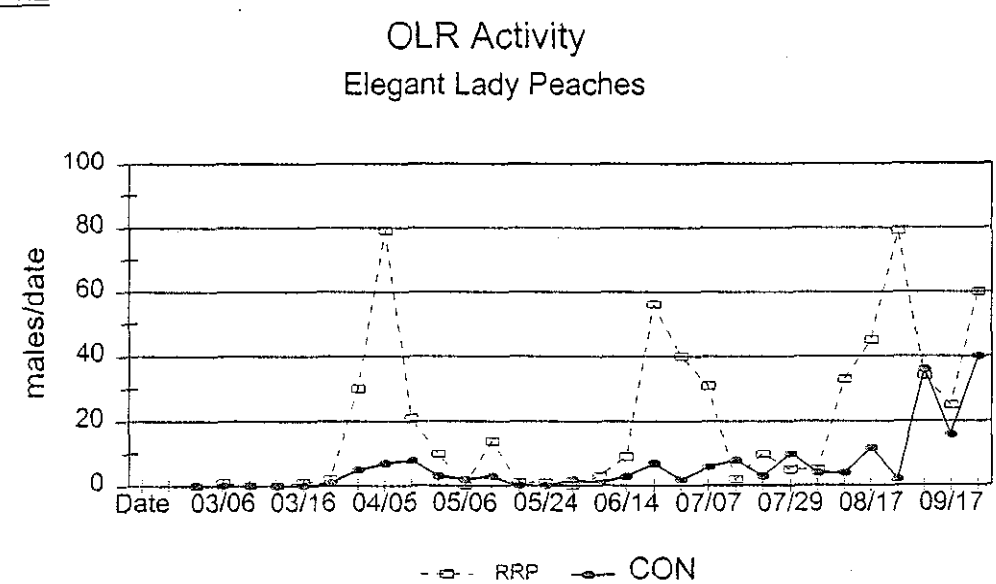


Figure 1.3

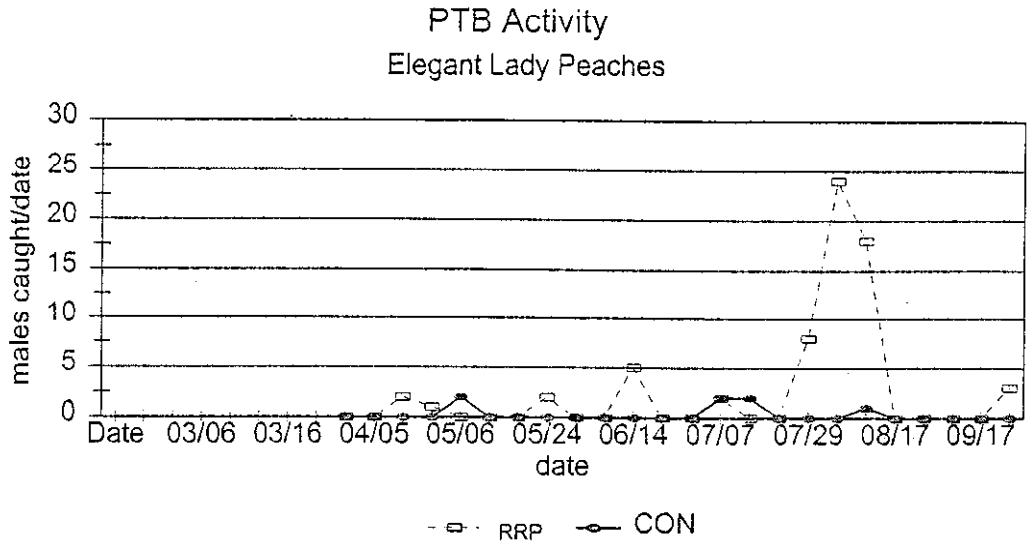


Figure 1.4

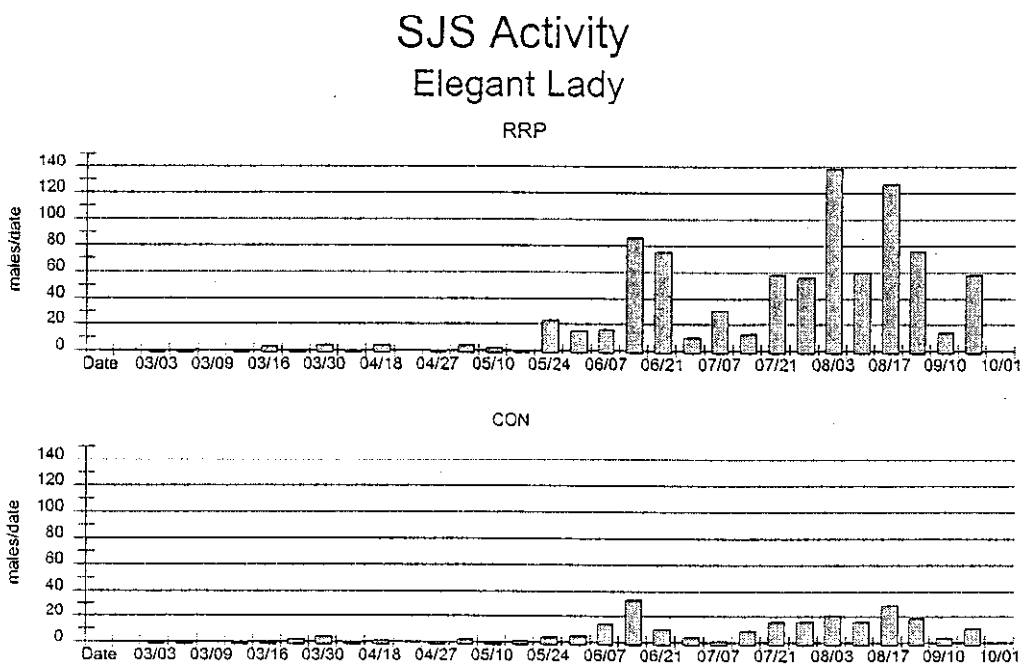


Figure 1.5

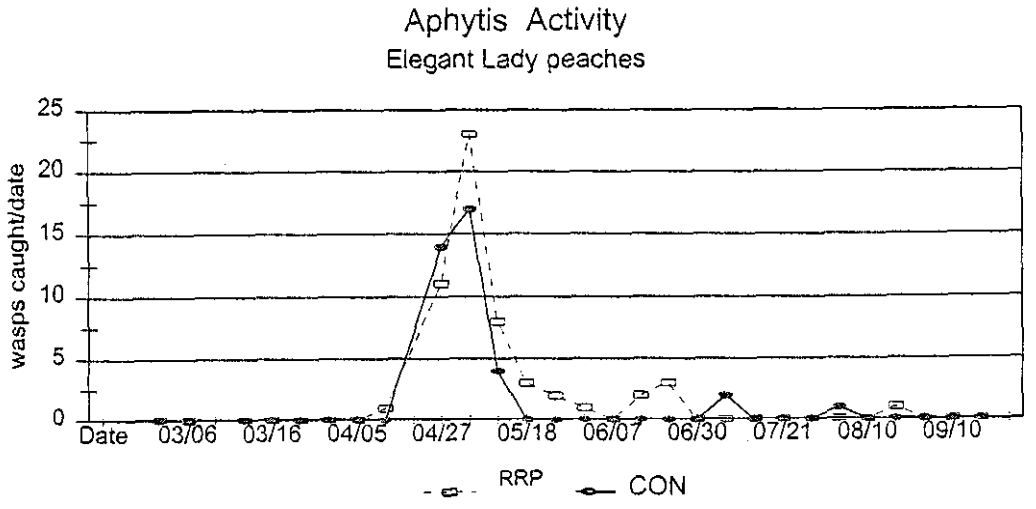
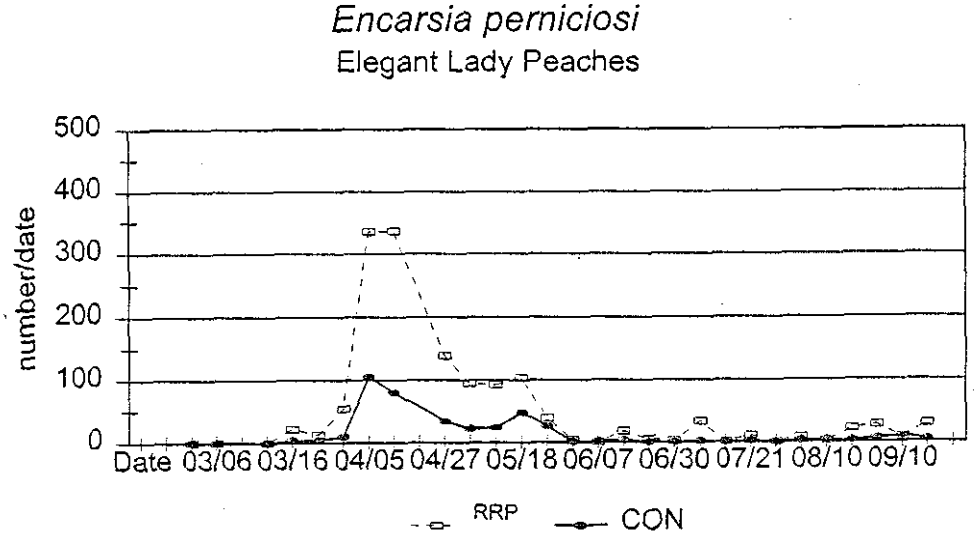


Figure 1.6



Grand Rosa Plums Pheromone Trapping Counts

Figure 2.1

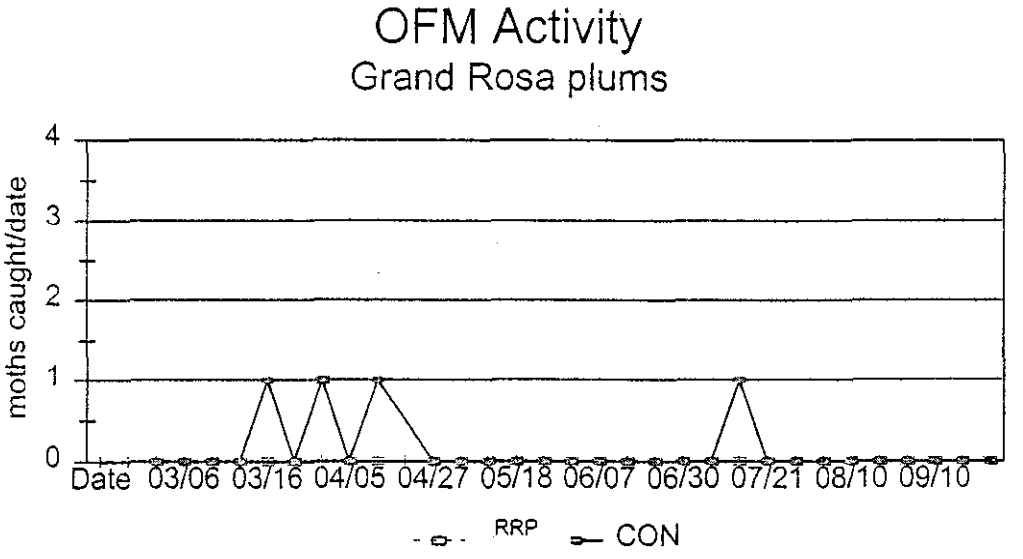


Figure 2.2

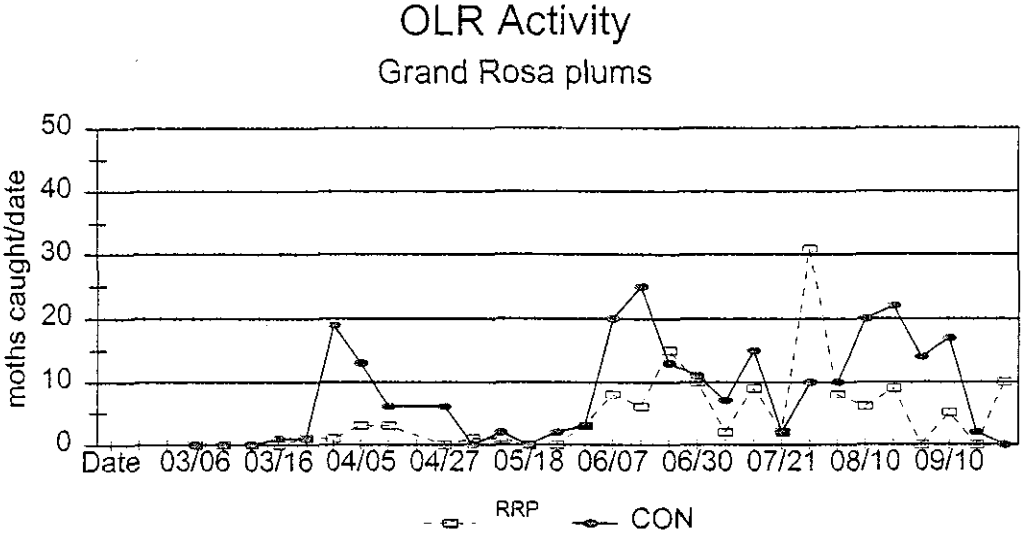


Figure 2.3

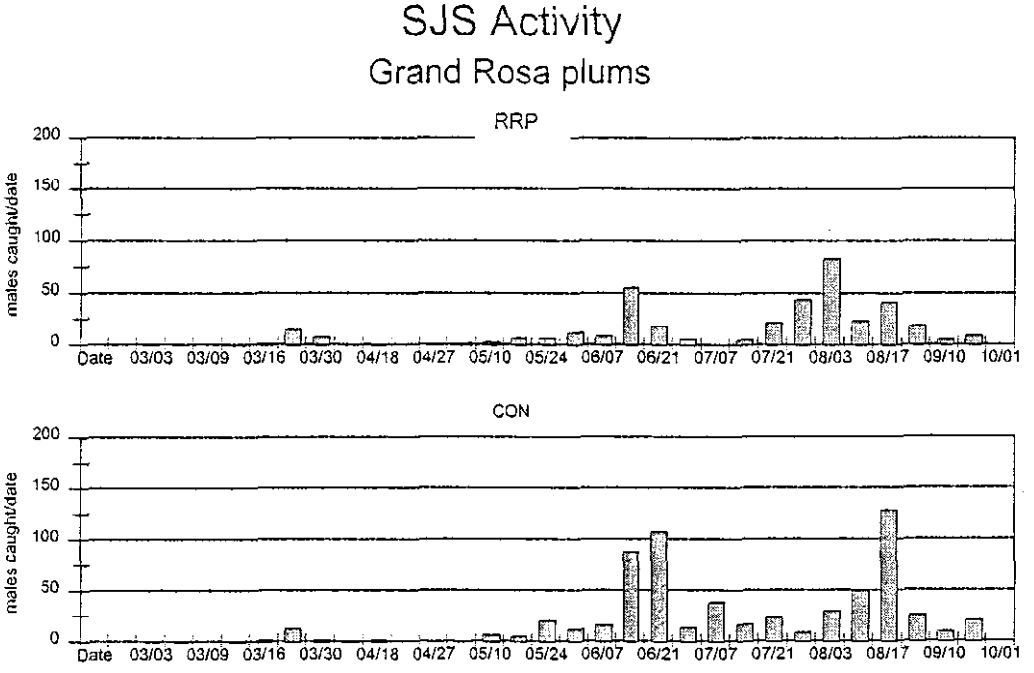


Figure 2.4

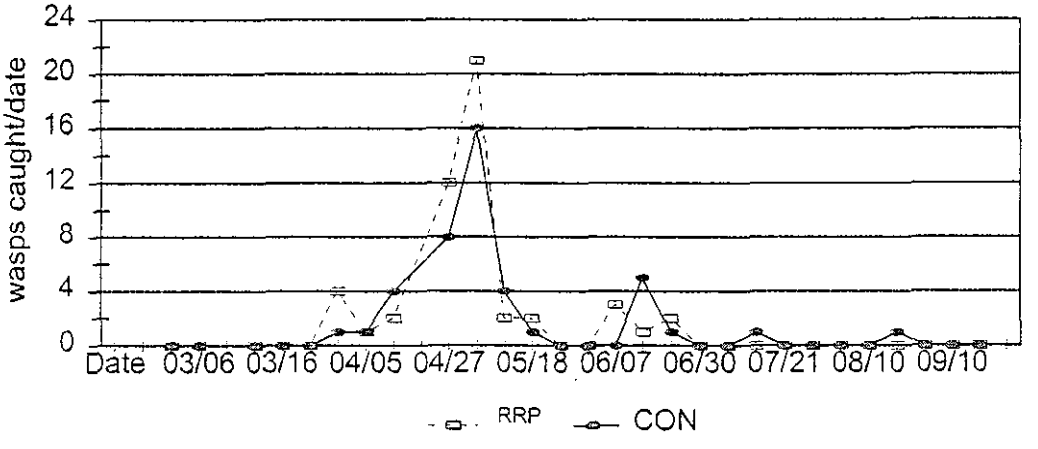
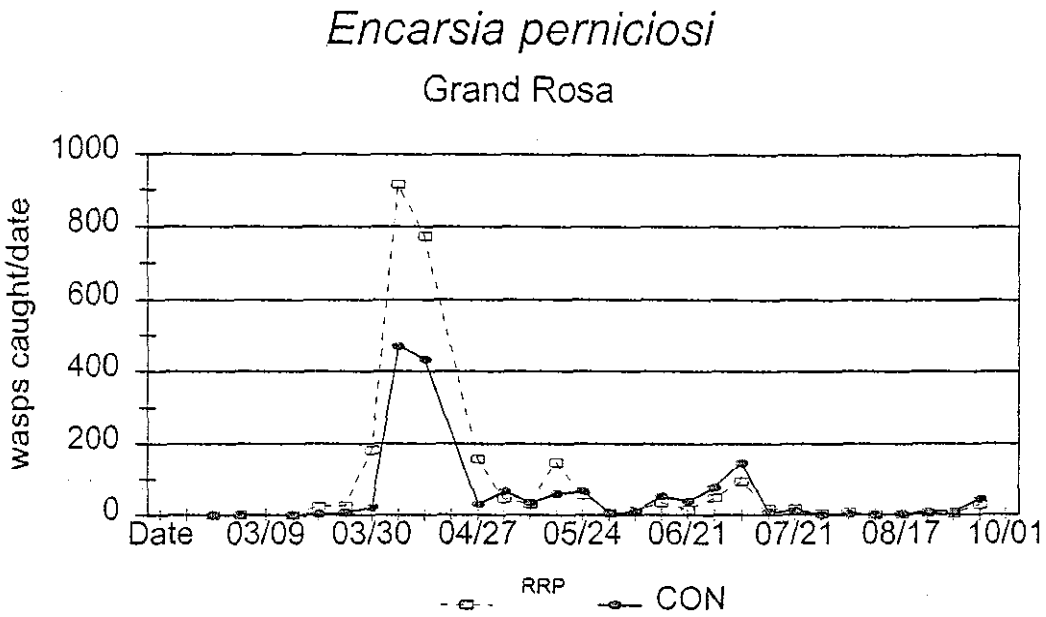


Figure 2.5



Red Jim Nectarines Pheromone Trapping Counts

Figure 3.1

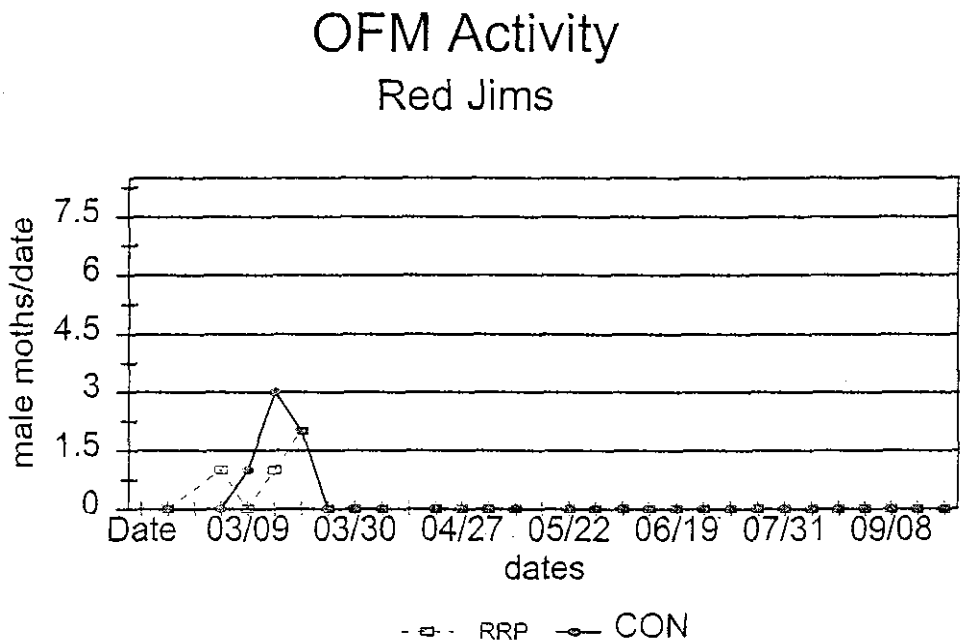


Figure 3.2

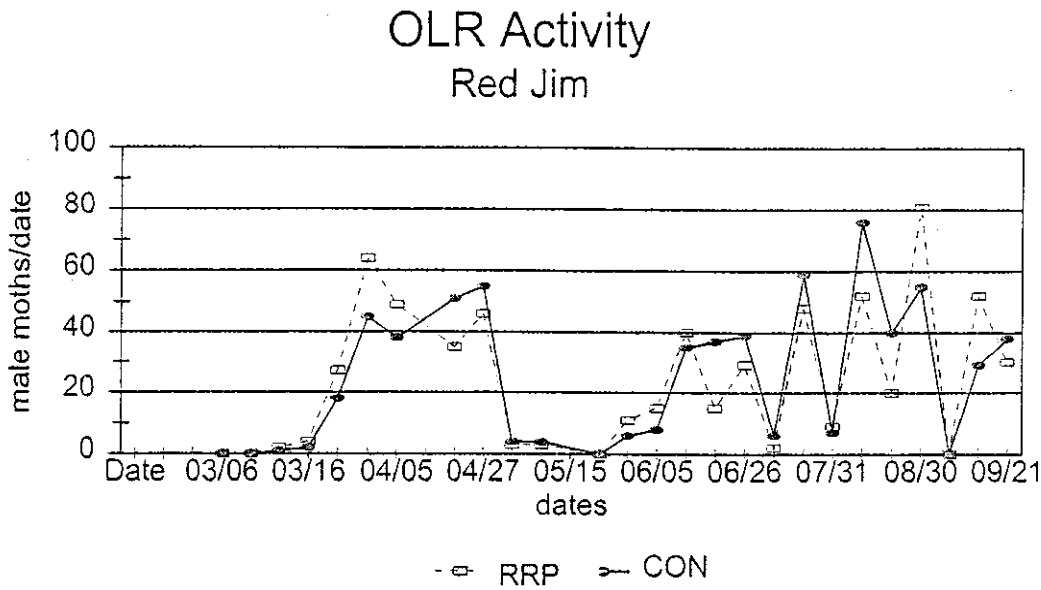


Figure 3.3

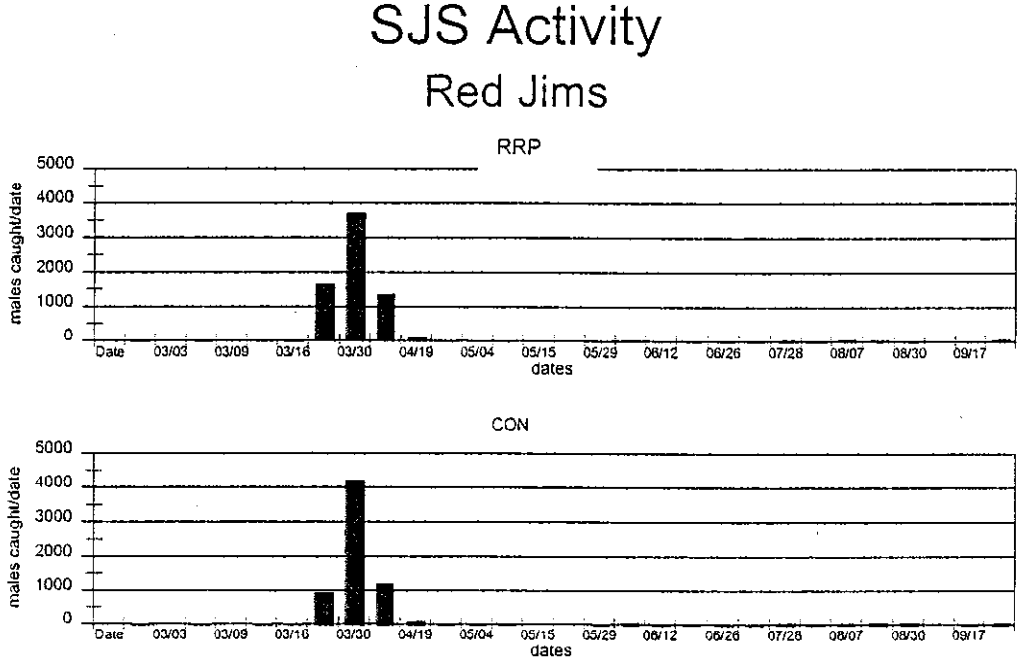


Figure 3.4

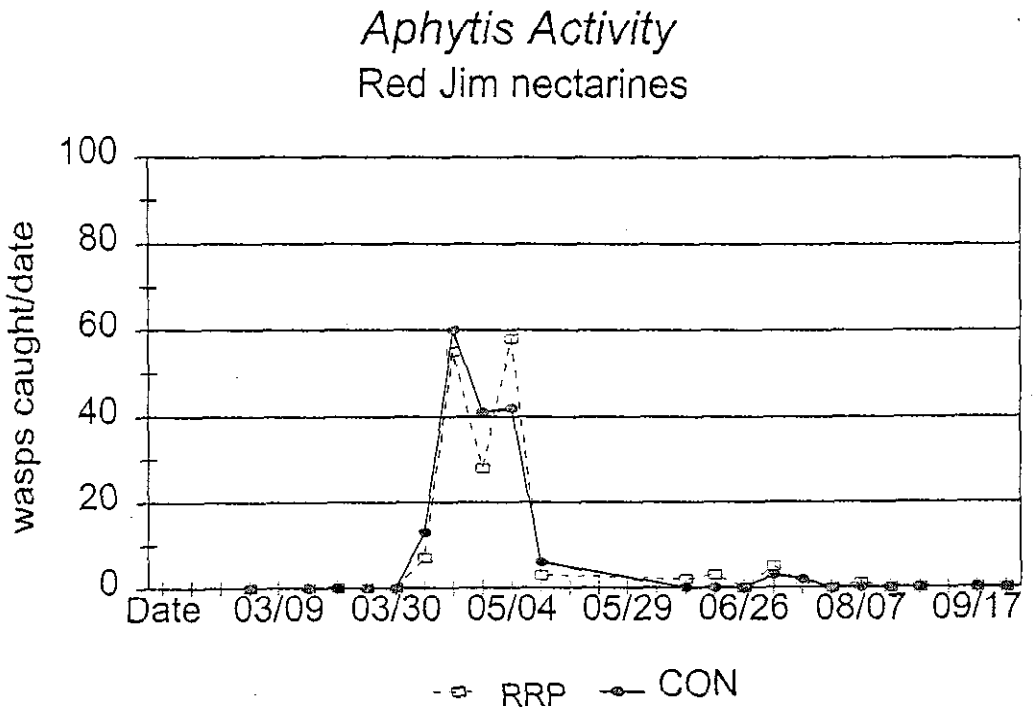
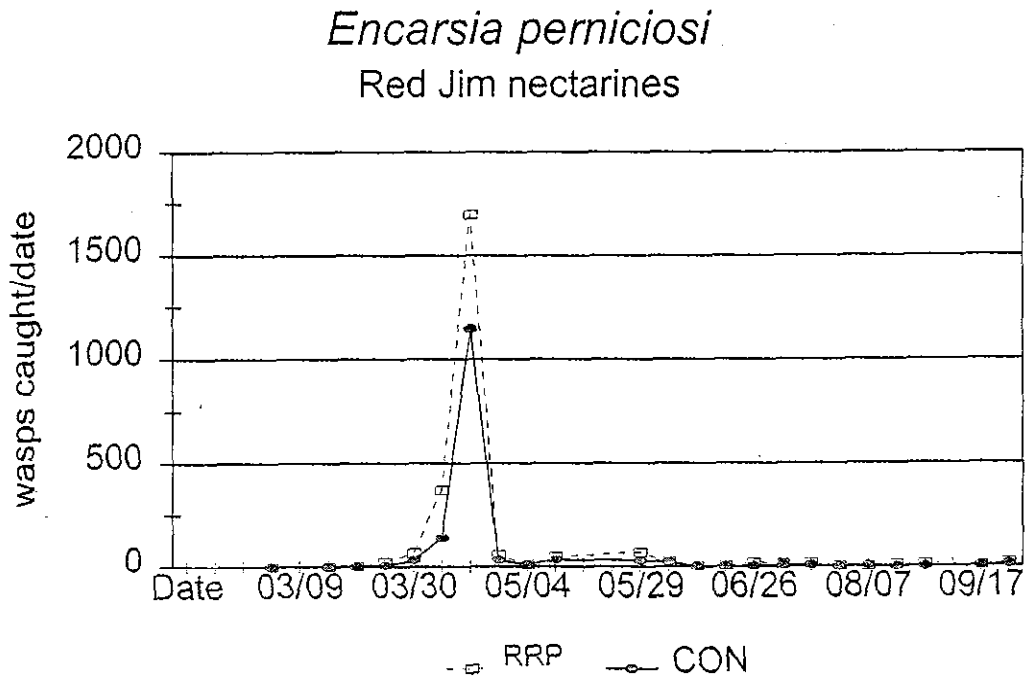


Figure 3.5



Royal Glo Nectarines Pheromone Trapping Counts

Figure 4.1

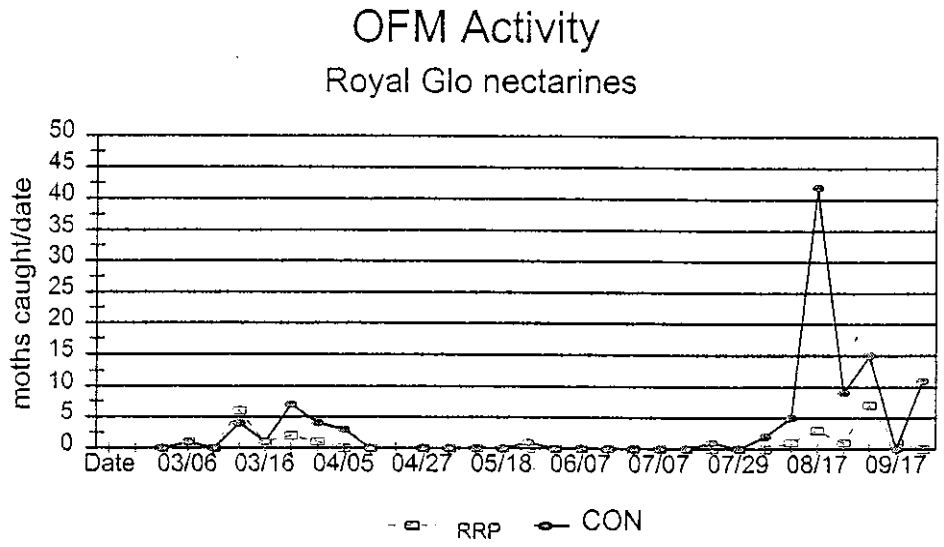


Figure 4.2

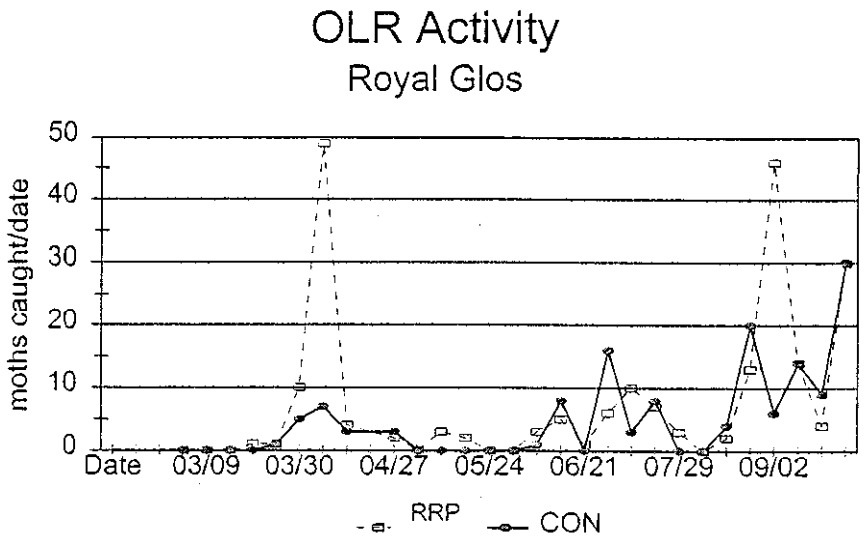


Figure 4.3

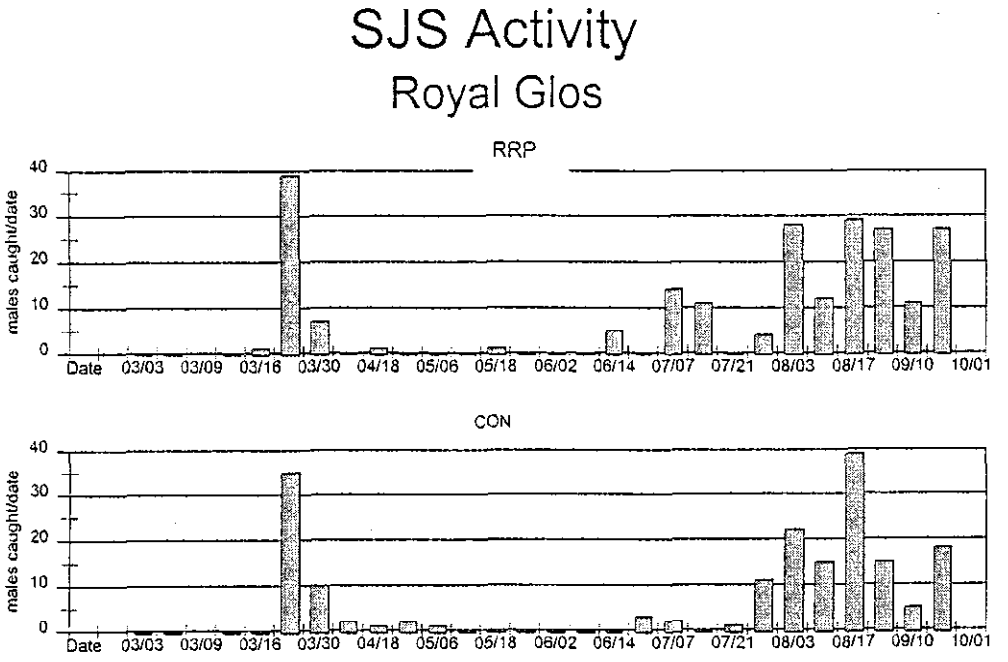


Figure 4.4

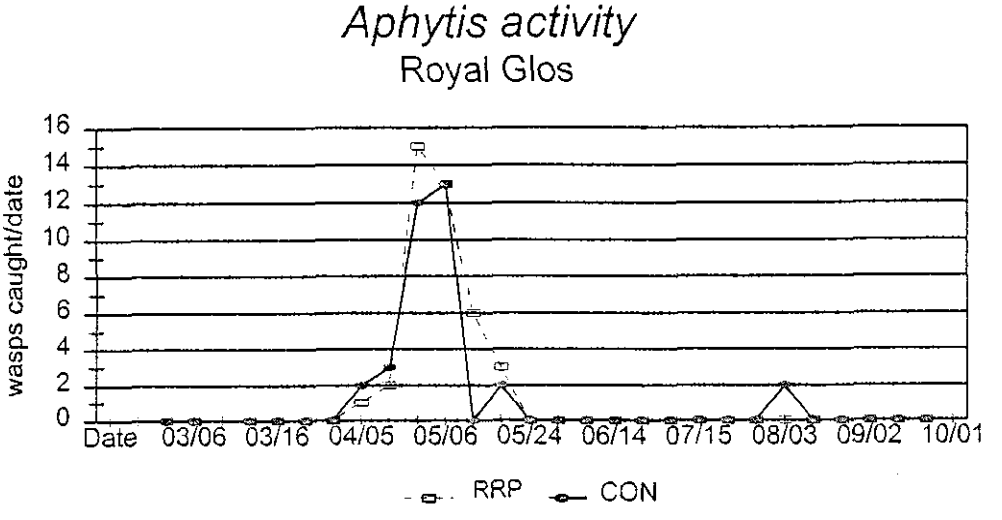
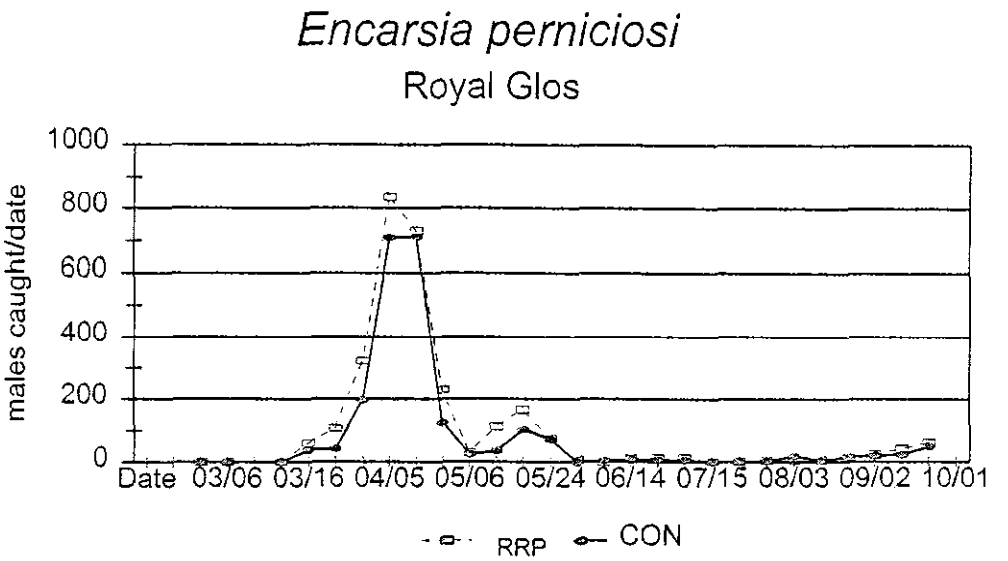


Figure 4.5



Summer Red Nectarines Pheromone Trapping Counts

Figure 5.1

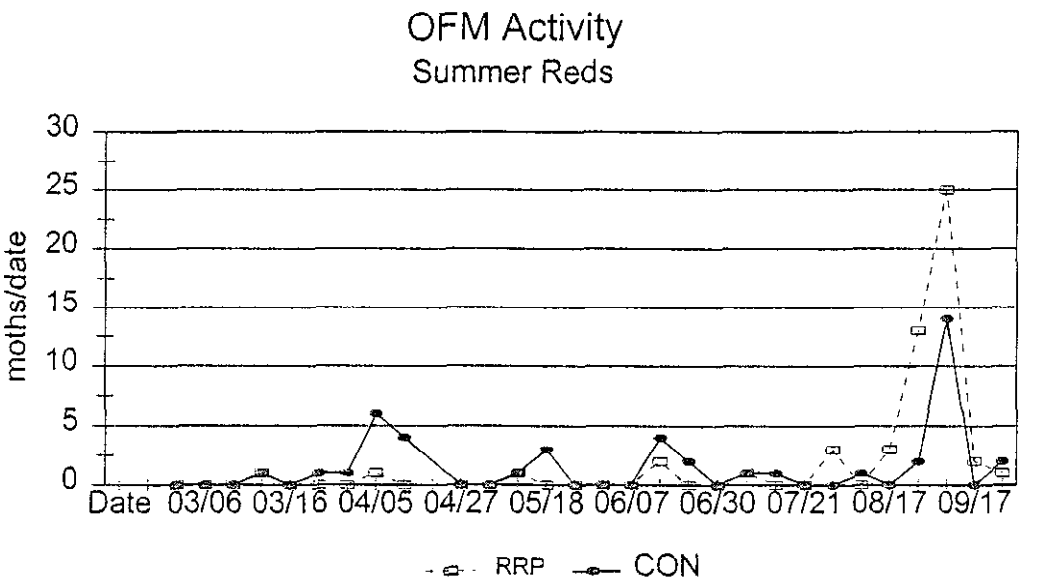


Figure 5.2

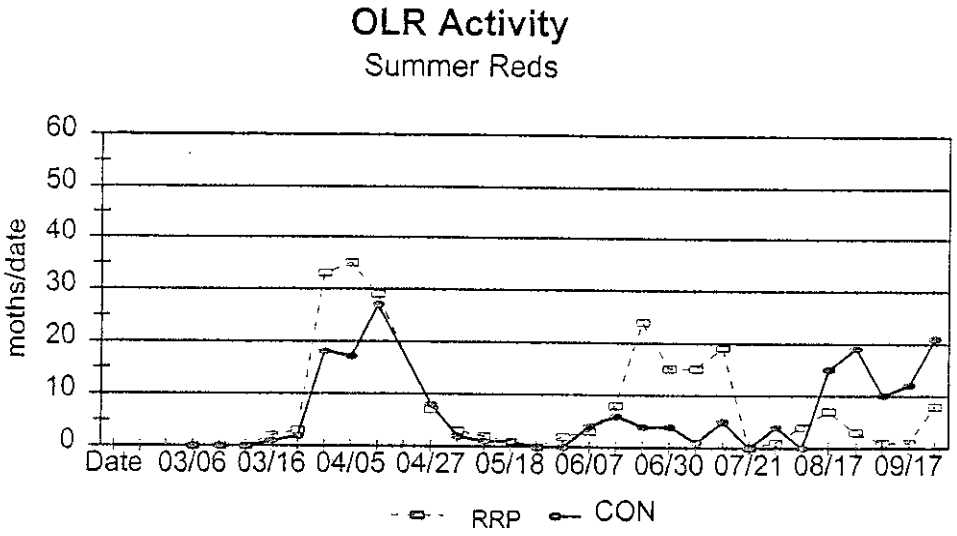


Figure 5.3

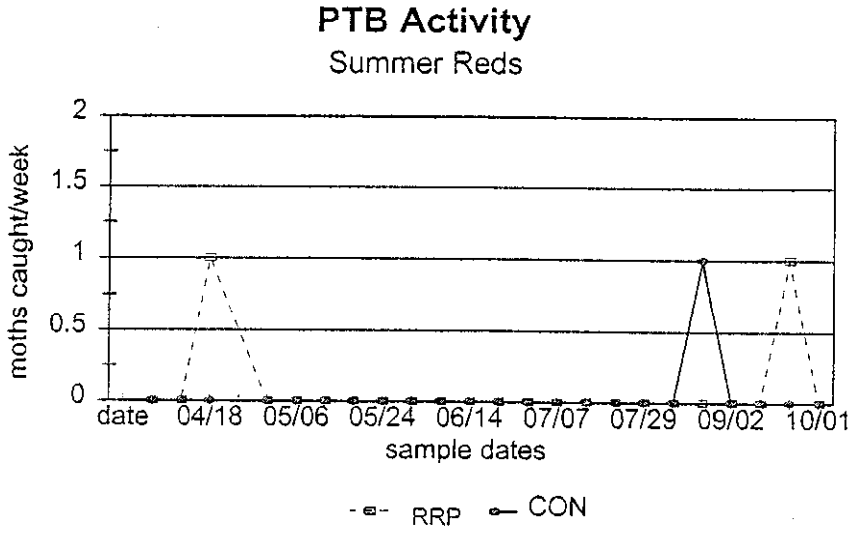


Figure 5.4

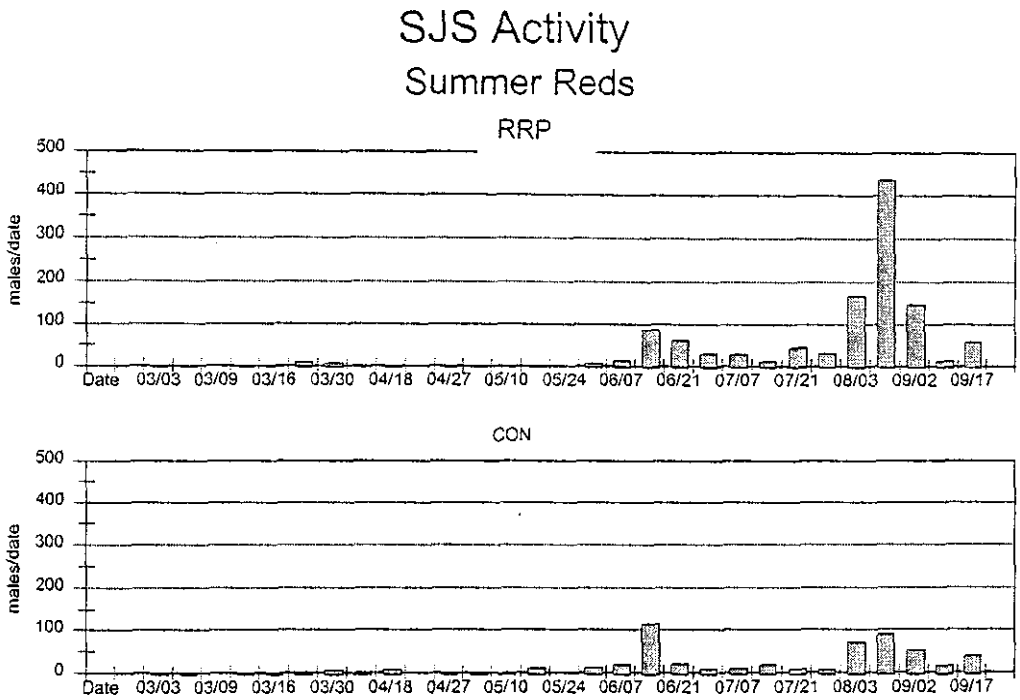


Figure 5.5

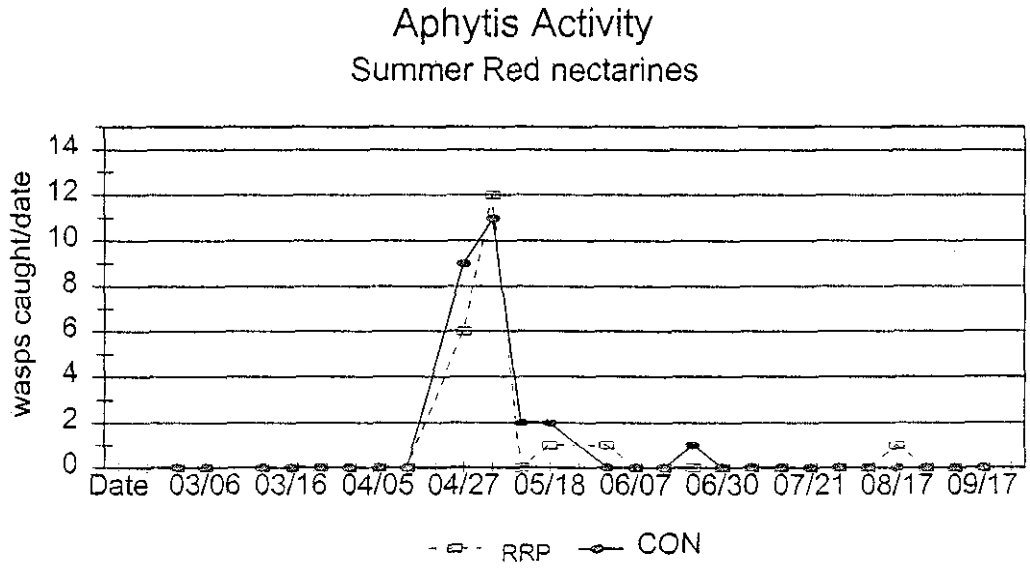
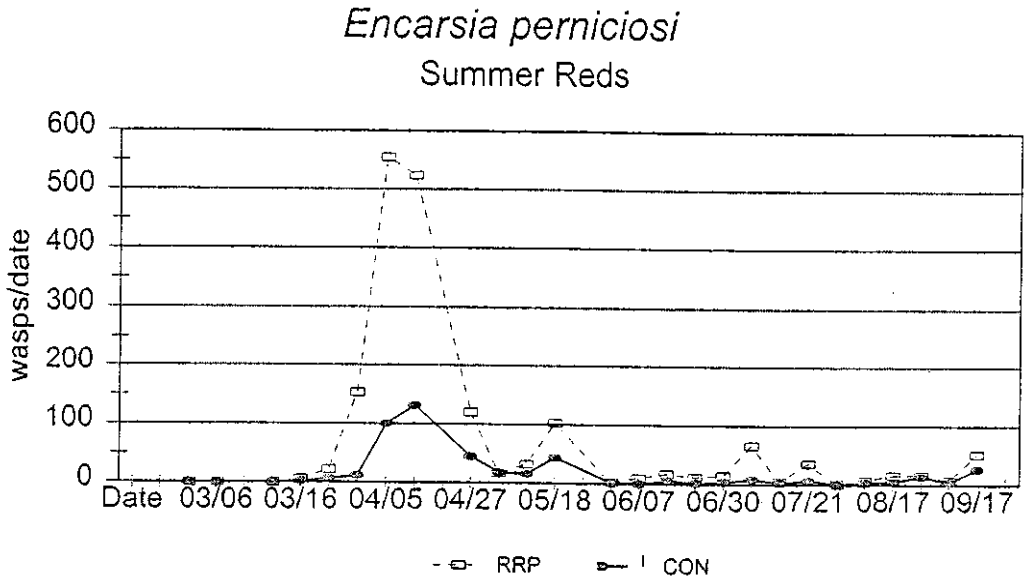


Figure 5.6


Encarsia perniciosi
Summer Reds
600
500
400
300
200
100
0
wasps/date
Date 03/06 03/16 04/05 04/27 05/18 06/07 06/30 07/21 08/17 09/17
RRP
CON

Tables

Table 1.

Results of bloom-time applications at 50% petal-fall for thrips control.

Materials Tested	Thrips Damage (%)	SJS Present (%)	Undamaged Fruit (%)
Agri-Mek®	12.1a	8.9a	63.2a
Carzol®	7.5a	58.1 b	35.6 b
Esteem®	15.8ab	15.9a	60.9a
Success®	10.4a	30.3a	57.2a
Untreated	22.3 b	33.4a	45.9ab

Numbers followed by the same letter(s) are not significantly different (DMRT, p=0.05).

Table 2.

Percentage of Fruit Without Insect Damage (Fresno and Kings Counties)*

	EL	SR	RG	GR	RJ	Overall
RRP	98.4% a *N = 900*	88.8% a *N = 1300*	90.5% a *N = 500*	81.7% a *N = 1100*	77.9% a *N = 1400*	86.19% a *N = 5200*
CON	99.2% a *N = 900*	91.3% a *N = 1300*	91.4% a *N = 500*	88.2% a *N = 1000*	81.4% a *N = 1400*	89.34% b *N = 5100*

* Differing letters in each column indicate significant differences (paired t-test, alpha = 5%)

Table 3.

Percentage Cull Rate at Harvest (Fresno and Kings Counties)[1]

	EL	SR	RG	GR	RJ	Overall
RRP	1.0% a *N = 200*	4.5% a *N = 400*	14.0% a *N = 100*	11.0% a *N = 300*	2.3% a *N = 300*	5.69% a *N = 1,300*
CON	1.0% a *N = 200*	3.5% a *N = 400*	14.0% a *N = 100*	7.0% a *N = 300*	2.7% a *N = 300*	4.53% a *N = 1,300*

[1] Differing letters in each column indicate significant differences (ANOVA, alpha = 5%)

The following abbreviations are used to describe the varieties in Table 2 and Table 3.
EL = Elegant Lady peach, **SR** = Summer Red nectarine
RG = Royal Glo nectarine, **GR** = Grand Rosa plum
RJ = Red Jim nectarine

Table 4.

Percentage of Insect Damage (Yuba County)

Practice/variety/county	OFM	PTB	Total OFM/PTB	OBLR	SJS	Katydid	Thrips	Lygus	Total % damage
RRP/C-Yuba	0	0	0.4	2.0	0	0	0	2.2	4.6
Standard/C-Yuba	0	0	0	1.8	0	0	0	2.8	4.6
RRP/R-Yuba	0	0	0	5.0	0	0	0	1.6	6.6
Standard/R-Yuba	0	0	0	0.8	0	0	0	0.2	1
RRP/SH-Yuba	0.1	0	4.4	3.2	0	0	0	0.7	8.3
Standard/SH-Yuba	0.1	0	1.2	2.6	0	0	0	0.3	4.1

The following abbreviations are used to describe the varieties in Table 4.

C= Carson Peach (harvested 7/24 and 7/25)
R=Ross Peach (harvested 8/14 and 8/15)
SH= Starn Peach (harvested 8/21 and 8/22) or Hesse Peach (harvested 8/24)